Intra-operative bronchoalveolar lavage in thoracic surgery

Qsous G MD* , Healy DGProf.

*correspondence author: Ghaith Qsous , Cardiothoracic registrar , St. Vincent's university hospital – Ireland

ABSTRACT

Objective : Chest infection is one of the most common complications after thoracic surgery, we aim to investigate the usefulness of intra-operative bronchoalveolar washing to help decrease the rate of postoperative chest infection and predict the causative microorganism.

Methods : This is a retrospective study including one hundred patients who underwent different thoracic surgeries in St. Vincent University Hospital from June 2013 to March 2020. All patients underwent intra-operative bronchoalveolar lavage before beginning the surgery. Also, a bronchial washing sample was sent for microbiological analysis.

Results : One hundred patients were included in our study. There were 39 males and 61 females, with a mean age of 61 years. Out of 100 surgery, there were 16 cases performed by open thoracotomy, 13 robotic-assisted thoracoscopic surgery (RATS) and 71 cases with video-assisted thoracoscopic surgery (VATS). Additionally, there were 53 cases as primary lung cancer, 16 cases as secondary lung cancer (metastasis) and 31 benign cases. Chest infection was noticed in 12 patients (12%). Out of these 12 patients, there were 7 patients (58.3%)have a positive culture from the bronchoalveolar washing. The mean duration of postoperative hospital stay was 6.1 days.

Conclusion : Adopting the intra-operative bronchoalveolar lavage in thoracic surgery can decrease the rate of chest infection and predict the causative microorganism. Consequently, that leads to a decrease in the length of hospital stay.

Keywords: Bronchoalveolar lavage, chest infection, thoracic surgery

I.   INTRODUCTION :

Chest infection post thoracic surgery around 20% and consider one of the most common complications [1]. Additionally, the mortality rate within this group can be around 22-67%, especially with pneumonia [2]. Also, a chest infection can lead to an increase in the length of hospital stay, increase the cost of treatment, and delay in adjuvant treatment if indicated [3].

The bronchial tree is usually sterile in healthy people. Though patients with an impaired immune response to infection such as COPD, lung cancer can increase the risk of airway colonization and as a result the chest infection [2]. Also, many risk factors can increase the risk of chest infection such as smoking and post-operative pain, open surgical approach, etc [4][5][6].

Moreover, the preoperative bacterial colonization in the airway considers as an independent risk factor causing a postoperative lung infection [2][7]. There are few studies discussed the correlation between the airway bacterial colonization and the incidence of chest infection in the postoperative period. Also, there are few data about the role of intraoperative bronchoscopy and bronchoalveolar lavage as a diagnostic and prophylactic approach to decrease the rate of chest infection in thoracic surgery [2][8].

Based on the above, we aimed to study the use of perioperative bronchoalveolar washing and the benefit to diagnose the bacterial microorganism which is responsible for a postoperative chest infection. Also, the prophylactic role of bronchoalveolar washing to decrease the incidence of chest infection.

II.   METHODS :

Patients and data collection :

This is a retrospective study including one hundred patients who underwent different thoracic surgeries in St. Vincent University Hospital from June 2013 to March 2020. All patients underwent intra-operative bronchoalveolar lavage before beginning the surgery. Also, a bronchial washing sample was sent for microbiological analysis. Data was collected from the patient's files after the approval from the ethical committee in St. Vincent's university hospital.

Procedure :

Perioperative flexible bronchoscopy was performed during anesthesia and endotracheal intubation immediately before the surgical procedure. Initially, an inspection of the bilateral bronchial tree to evaluate for any endobronchial lesion or tumor invasion. Then a 50cc of normal saline was injected in each side and aspirated again.

Accordingly, two samples from each side were sent for laboratory analysis, one as a cytology analysis and another one for microbiology analysis. This procedure was done by the cardiothoracic consultant or the registrar and it takes around 5-10 minutes.

Antibiotics, and definitions :
All patients have received a prophylactic single dose of antibiotics, usually first-generation cephalosporin, which given before skin incision.
Patients were diagnosed with chest infection based on clinical presentation (fever and productive cough), and on a blood test (high white blood cells and high C-reactive protein). Besides, other sources of infection should be excluded. Radiological findings used also to confirm the diagnosis.

III.   RESULTS :
Between June 2013 and March 2020, 100 patients underwent different thoracic surgeries for benign and malignant diseases. Of these, there was 40 (40%) male patient and 60 (60%) female and the mean age was 61 years old. Also, 56 patients (56%) were active or former smokers while 44 (44%) was a non-smoker. Besides, there are 23 patients (23%) who suffered from chronic lung disease. It is worth mentioning that just 16 patients (16%)underwent open surgery while others underwent minimally invasive surgery (video-assisted or robotic-assisted thoracoscopic surgery). Patient characteristics, type of resection, and the disease are summarized in Table 1.

Perioperative   Airway   Colonization   and postoperative chestinfection :
Out of 100 patients included in this study, 11 (11%) patients had a chest infection . while 26 patients (26%) had positive culture from the bronchoalveolar washing and 66 patients (66%) found pus cells in their microbiology analysis. the mean length of stay (LOS) was 5.6 days. Table 2.
The 26 patients who had a positive culture in the bronchoalveolar lavage were analyzed. 16 patients had gram-positive cocci including (Staphylococcus aureus,   Streptococcus   pneumonia,   and Streptococcuspseudopneumoniae). Additionally, 21 patients had pus cells in the microbiological culture. Table 3

Postoperative Respiratory Infection :
It is worth mentioning that out of 11 patients who had chest infection after the surgery, 8 patients (73%) and 7 patients (63.5%) had positive culture and   pus   cells   from   the   perioperative bronchoalveolar   washing   respectively.   Also,

preoperative CRP was elevated in 3 patients (27%). Table 4
Further analysis for the 11 patients who had chest infection showed that gram-positive cocci and staphylococcus aureus were found in 4 patients by the bronchoalveolar washing. Moreover, one patient out of 11 had two microorganisms in the bronchoalveolar washing. Table 5

IV.   DISCUSSION :
Surgery is the main approach of treatment for lung cancer especially in the early stage of non-small cell lung cancer (NSCLC). However, mortality and morbidity still high mostly due to respiratory complications. Also, some patients who suffer from chronic obstructive pulmonary diseases, interstitial lung disease, and heavy smoker are at higher risk to develop post-operative lung infection [9][10][11][12] .

Perioperative BAL can decrease the rate of chest infection and predict the causative microorganism. Consequently, that leads to a decrease in the length of hospital stay.

Jones et al .in 1991 from St. George's hospital in the United Kingdom were first who discussed the benefit of BAL in predicting postoperative chest infection in thoracic surgery. His prospective study on 75 patients who underwent thoracic surgeries showed similar results to our study, that the culturing of bacterial pathogens from BAL from the resected lung is a significant predictor of postoperative chest infection in patients undergoing lung resection.

They found 42% of patients who had a positive culture in BAL, developed a postoperative chest infection. In conclusion, a significant association was demonstrated between the colonization of the lower respiratory tract and the occurrence of postoperative chest infection [8].

Another prospective cohort study by Belda et al. aimed to evaluate the relationship between airway colonization in the BAL samples and the incidence of postoperative chest infection. Their study included 78 patients and 83% of patients had airway colonization. Postoperative chest infection was identified in 24 patients (31%). These results were similar to our results which showed that the existence of perioperative airway colonization by bacterial microorganism are independent predictors of postoperative respiratory infection. They concluded that postoperative chest infection can be decreased by controlling the causes of airway colonization [2].

Oor et.al from Netherland did a retrospective study that included 121 patients who underwent open lung resection for lung cancer.

They studied the correlation between positive intra-operative bronchial culture and post-operative lung infection. They found that 88% of patients with a positive culture developed a lung infection during the recovery period. The multivariate analysis showed that the positive culture is an independent risk factor for the development of lung infection postoperatively [1].

Based on the above studies, there is a strong correlation between positive bronchial culture and post-operative lung infection. As a result, perioperative BAL can help to predict the high-risk patients and the bronchial washing with a clearance of the bronchial secretions can decrease the risk of infection in this group of patients. There is a lack of studies about the role of BAL in the prevention of postoperative lung infection and our study can initiate focusing on utility BAL perioperatively especially in high risk patients.

Limitation of our study, is a retrospective study from a single-center, with clearly a small number of patients which may have an adverse impact on the outcome. However, this is perhaps a worthy attempt to do prospective randomized trials in the future.

V. CONCLUSION :

In conclusion, adopting the intra-operative bronchoalveolar lavage in thoracic surgery can decrease the rate of chest infection and predict the causative microorganism. Consequently, that leads to a decrease in the length of hospital stay.

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Name	value	Total (100 patients)
Sex	M F	40(40%) 60(60%)
DM	Yes No	9(9%) 91(91%)

HTN	Yes	22(22%)
	No	78(78%)
IHD	Yes	7(7%)
	No	93(93%)
Lung disease	Yes	23(23%)
	No	77(77%)
Smoking	Yes + ex	56(56%)
	No	44(44%)
Type of Surgery	Open	16(16%)
	VATS	72(72%)
	RATS	12(12%)
Type of resection	Wedge resection	45(45%)
	Lobectomy	48(48%)
	Pneumonectomy	1(1%)
	Thymectomy	3(3%)
	Chest wall resection	2(2%)
	Pleurectomy	1(1%)
Stage	Benign	30(30%)
	I	33(33%)
	II	6(6%)
	III	7(7%)
	Metastasectomy	18(18%)
	Thymoma	3(3%)
	Chest wall tumor	2(2%)
	Pneumothorax	1(1%)

Table 1 – Patients characteristics .

name	value	Results (100 patients)
Chest infection	Yes	11(11%)
	No	89(89%)
Culture results	Positive	26(26%)
	Negative	74(74%)
Pus cells	Positive	66(66%)
	Negative	34(34%)
Mean Age		61 years old
Mean LOS		5.6 days

Table 2 – results of patients .

Name	Value	Total (26 patients)
Bronchoscopy culture microorganism	Penicillium species	2
	Gram-positive cocci	10
	Gram-Negative Bacilli	2
	Staphylococcus aureus	4
	Candida species	3
	Streptococcus pneumoniae	1
	Aspergillus fumigatus	1
	Streptococcus pseudopneumoniae	1
	Haemophilus influenzae	2

Pus cells	Yes No	21 5
Chest infection	Yes No	8 18
Preoperative CRP	Normal High N\A	6 2 18

Table 3 – patient with positive bronchoalveolar lavage

name	value	Total (11 patients)
Sex	M F	3(27%) 8(73%)
DM	Yes No	3(27%) 8(73%)
HTN	Yes No	4(36%) 7(64%)
IHD	Yes No	1(9%) 10(91%)
Lung disease	Yes No	3(27%) 8(73%)
Smoking	Yes + ex No	6(54%) 5(46%)
Type of Surgery	Open VATS RATS	3(27%) 8(73%) 0
Type of resection	Wedge resection Lobectomy Pneumonectomy Thymectomy Chest wall resection	5(45.5%) 5(45.5%) 0 0 1(9%)
Stage	Benign I II III Metastasectomty Thymoma Chest wall tumor	4(36%) 1(9%) 2(18.5%) 1(9%) 2(18.5%) 0 1(9%)
Culture results	Positive Negative	8(73%) 3(27%)
Pus cells	Positive Negative	7(63.5%) 4(36.5%)

Pre-operative WBC+ Neutrophilis	Normal	10(91%)
	Elevated	0
	N\A	1(9%)
Pre-operative CRP	Normal	4(36.5%)
	Elevated	3(27%)
	N\A	4(36.5%)

Table 4 – patient with chest infection characteristics .

Patient	Bronchoscopy culture	Sputum culture	Bronchoscopy pus cells	Preoperative CRP
1	Penicillium species	N\A	No	N\A
2	Gram +ve cocci	Haemophilus influenzaestenotrophomonasmaltophilia	Yes	Normal
3	E.coli\Candida species	N\A	Yes	N\A
4	Staphylococcus aureus	N\A	Yes	Normal
5	Negative	N\A	No	High
6	staphylococcus aureus	E.coli	Yes	Normal
7	Negative	N\A	no	High
8	Aspergillus fumigatus	Staphylococcus aureus Candida albicans	Yes	N\A
9	Gram+ve cocci	N\A	Yes	High
10	Negative	N\A	No	Normal
11	Haemophilus influenzae	Negative (after 1 week)	Yes	N\A

Table 5 –patients with chest infection and bronchoalveolar lavage results with sputum culture and preoperative CRP .